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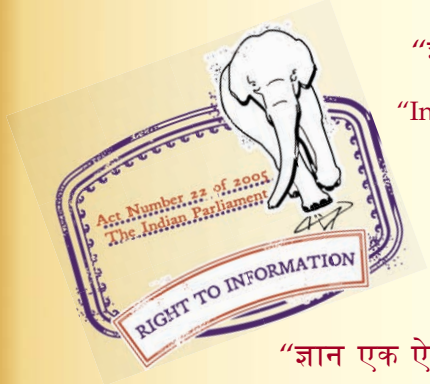

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IS : 6648 - 1972
(Reaffirmed 2006)

Indian Standard

SPECIFICATION FOR CARBON ELECTRODES FOR DRY CELLS AND BATTERIES

UDC 621·3·035·222·3 : 621·352·132

INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 1

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December 1972

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SPECIFICATION FOR CARBON ELECTRODES FOR DRY CELLS AND BATTERIES

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 27 July 1972, after the draft finalized by the Primary Cells and Batteries Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 Carbon electrodes are being manufactured in the country at present for use with dry cells and batteries and hence need has been felt to lay down uniform requirements for physical, mechanical and electrical properties of the carbon electrodes.

0.3 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

---

1. SCOPE

1.1 This standard lays down the dimensions, tests and performance requirements of carbon electrodes for dry cells and batteries.

2. TERMINOLOGY

2.1 For the purpose of this standard, the following definitions and those given in IS : 1885 (Part XV)-1967† shall apply.

2.1.1 *Crack* — Splitting of electrode surface.

2.1.2 *Blister* — Marked projection over the electrode surface formed in the shape of bubble or raised irregularity.

2.1.3 *Pitting* — Surface depression on the electrode.

---

*Rules for rounding off numerical values (*revised*).

†Electrotechnical vocabulary: Part XV Primary cells and batteries (superseding IS : 1025-1957).

2.1.4 *Wetting Time* — The time taken for the electrode when immersed in a certain electrolyte solution to obtain an unbroken surface coating of the solution after removal from the solution.

2.1.5 *Acceptance Tests* — Tests carried out on samples taken from a lot for the purpose of acceptance of the lot.

2.1.6 *Type Tests* — Tests carried out to prove conformity with the requirements of this standard. These are intended to prove the general quality and design of a given type of battery.

3. DESIGNATION

3.1 Electrodes shall be designated by the letter E preceded by the Indian Standard designation of the unit cell where the electrode may be used. The cell designation shall be separated from the letter 'E' by a hyphen.

3.2 Where electrode is required in more than one length for the same cell or battery, numerical suffix like 1, 2, 3, etc, shall be used with the letter E to define second, third, fourth, etc, choice in length of the electrode, the first choice being defined by the letter E itself without any suffix.

Examples:

1) Electrode used for R6 cell will be designated as R6-E.
2) First and second alternative lengths of the electrode required for R 10 cell shall be designated as R 10-E and R 10-E1.

4. DIMENSIONS

4.1 Nominal overall dimensions of carbon electrodes for dry cells and batteries shall be as specified in Table 1.

5. APPARENT DENSITY

5.1 Apparent densities, expressed in g/ml of carbon electrodes for cells and batteries shall be in accordance with col 2 of Table 2.

6. FLEXURAL STRENGTH

6.1 Flexural strengths expressed in N/mm^2 of carbon electrodes for cells and batteries shall be in accordance with col 3 of Table 2.

7. ELECTRICAL RESISTIVITY

7.1 Electrical Resistivity expressed in micro-ohm.m of carbon electrodes for cells and batteries shall be as given in col 4 of Table 2.

TABLE 1 NOMINAL OVERALL DIMENSIONS OF CARBON ELECTRODES

(*Clause* 4.1)

Designation	Diameter	Tolerance on Diameter	Length	Tolerance
(1)	(2)	(3)	(4)	(5)
	mm	mm	mm	mm
R 6-E	4	± 0·05	47	± 0·25
R 10-E	6	± 0·05	34	± 0·4
R 10-E1	6	± 0·05	35	± 0·4
R 12-E	6	± 0·05	54	± 0·4
R 12-E1	6	± 0·05	55	± 0·4
R 14-E	6	± 0·05	45	± 0·4
R 14-E1	6	± 0·05	46	± 0·4
R 14-E2	6	± 0·05	47	± 0·4
R 20-E	8	± 0·05	56	± 0·4
R 20-E1	8	± 0·05	57	± 0·4
R 20-E2	8	± 0·05	58	± 0·4
R 22-E	8	± 0·05	67	± 0·4
R 22-E1	8	± 0·05	68	± 0·4
R 22-E2	8	± 0·05	69	± 0·4
R 22-E3	8	± 0·05	70	± 0·4
R 25-E	8	± 0·05	87	± 0·4
R 25-E1	8	± 0·05	88	± 0·4

TABLE 2 APPARENT DENSITY, FLEXURAL STRENGTH AND ELECTRICAL RESISTIVITY OF CARBON ELECTRODES

(*Clauses* 5.1, 6.1 *and* 7.1)

Designation	Apparent Density g/ml *Min*	Flexural Strength N/mm^2 *Min*	Electrical Resistivity Micro-ohm.m *Max*
(1)	(2)	(3)	(4)
R 6-E	1·60	40	40
R 10-E	1·45	40	60
R 10-E1	1·45	40	60
R 12-E	1·45	40	60
R 12-E1	1·45	40	60
R 14-E	1·45	40	60
R 14-E1	1·45	40	60
R 14-E2	1·45	40	60
R 20-E	1·45	40	60
R 20-E1	1·45	40	60
R 20-E2	1·45	40	60
R 22-E	1·45	40	60
R 22-E1	1·45	40	60
R 22-E2	1·45	40	60
R 22-E3	1·45	40	60
R 25-E	1·45	40	60
R 25-E1	1·45	40	60

8. SURFACE CONDITION

8.1 Ends of electrodes shall be smoothly sawed and shall be square within 1°.

8.2 Electrodes shall have no chip ends, surface cracks, blisters and pittings.

8.3 Bow — The warpage and bow of the electrode is to be checked by passing through a gauge. The dimension of the gauge shall be as follows:

l_g = l_r,
d_g = d_r *Max* + 0·63 mm,
l_g = length of the gauge,
l_r = length of the electrode,
d_g = diameter of the gauge, and
d_r *Max* = maximum diameter of the electrode.

9. PARAFFIN CONTENT

9.1 Paraffin content expressed as percent by weight of electrodes shall be as follows:

Paraffin content for R 6-E electrode	1 to 3
Paraffin content for electrode types R 10-E, R 12-E, R 14-E, R 20-E, R 22-E, R 25-E	1 to 4

10. ELECTROLYTE WETTABILITY AND CREEPAGE

10.1 Electrolyte Wettability Test — Electrode when immersed in a solution containing 10·0 percent of zinc chloride, 25 percent ammonium chloride and 65 percent water (by weight) shall have a minimum wetting time of 15 min.

10.2 Electrolyte Creepage Test — Sample carbon electrode shall be tested by immersion for three quarters of their height in the electrolyte solution. The composition of electrolyte solution shall be same as described in **10.1**. The rods shall remain in the solution for 28 days and during this time the portion of the rod which is not immersed shall show no evidence of contamination by the solution.

11. TESTS

11.1 The following shall constitute the type tests:

a) Dimensions (*see* **4.1**),

b) Apparent density, flexural strength and electrical resistivity (*see* **5.1, 6.1** *and* **7.1**),

c) Surface condition (*see* **8**),

d) Paraffin content (*see* **9.1**),

e) Electrolyte wettability and creepage (*see* **10.1** and **10.2**), and

f) Checking of service performance (when agreed between the supplier and the customer) thorough practical test to ensure that final products meet all requirements specified in IS:203-1972* or IS:2576-1963†.

11.1.1 Number of samples for type tests shall be as follows:

For tests from (a) to (e)	10 No.
For test at (f)	50 No.

11.1.2 *Criteria for Conformity* — If there is any failure in any of the type tests twice the original number of samples shall be taken and subjected to all the tests. For conformity to type test no failure is permitted in the re-tests.

11.2 Acceptance Tests — Tests (a) to (e) of **11.1** shall constitute the acceptance tests.

11.2.1 *Sampling and Criteria for Acceptance* — Unless otherwise agreed the sampling procedure and criteria for acceptance shall be as given in Appendix A.

11.3 Test for Flexural Strength — Flexural strength is to be determined by placing the electrode under test horizontally on steel supports and exerting pressure vertically at the midlength of the electrode by a stellite faced knife edge till it breaks. The knife edge should be rounded to radius of 5 mm and should be coupled mechanically with a dynamometer. The edge of the supports shall be rounded to a radius of 2 mm. The distance of the point of support from the nearer end of the electrode should not be more than 5 mm. Crushing strength (S) is to be calculated in N/mm^2 using the formula:

$$S = 2{\cdot}5 \frac{FL}{d^3} \text{ N/mm}^2$$

where

F = force in newtons of the dynamometer at moment of breaking,

L = distance in mm between supports, and

d = nominal diameter of electrode in mm.

*Specification for dry batteries for flashlights (*third revision*).
†Specification for dry batteries for transistor radio receivers.

11.4 Measurement of Electrical Resistivity — Measurement is made of the voltage drop with a given current passing through a known length of an electrode having uniform cross section. The resistivity shall be computed from this measurement using the following formula and shall be expressed in micro-ohm.m:

$$\rho = \frac{aV}{I_l}$$

where

ρ = resistivity,
a = cross section in m^2,
V = voltage drop in volts,
I = current in amperes, and
l = length in m.

APPENDIX A

(*Clause* 11.2.1)

SAMPLING FOR ACCEPTANCE OF LOTS

A-1. LOT

A-1.1 In any consignment all the electrodes of the same designation manufactured by the same factory, during the same period, shall be grouped together to constitute a lot.

A-1.2 From each lot a certain number of electrodes shall be selected at random and subjected to acceptance tests. Any electrode failing to satisfy the appropriate requirements specified in the individual specification shall be considered as defective.

A-2. CRITERION FOR CONFORMITY

A-2.1 The actual number of electrodes to be selected from a lot shall be in accordance with Table 3, where N_1 is the size of the first sample. If the number of defectives found in this sample is less than or equal to C_1, the lot shall be considered as conforming to the requirements of the standard. If the number of defectives is equal to or greater than C_2, the lot shall be considered as not conforming to the requirements of the standard. If the number of defectives in the first sample lies between C_1 and C_2, a further sample of N_2 electrodes shall be taken and tested. If the number of defectives in the two samples combined is less than C_2, the lot shall be considered as conforming to the requirements of the standard, otherwise, the lot shall be considered as not conforming to the requirements of the standard.

TABLE 3 SAMPLING PLAN

(*Clause* A-2.1)

Lot Size	First Sample N_1	Second Sample N_2	$(N_1 + N_2)$	Acceptance Number C_1	Rejection Number C_2
(1)	(2)	(3)	(4)	(5)	(6)
Up to 100	3	6	9	0	2
101 to 200	4	8	12	0	2
201 ,, 500	7	14	21	0	3
501 ,, 800	10	20	30	0	3
801 ,, 1 300	13	26	39	0	5
1 301 ,, 3 200	20	40	60	1	5
3 201 ,, 8 000	25	50	75	1	6
8 001 ,, 22 000	35	70	105	2	7

NOTE — The sampling plan given in the table envisages that lots containing about 4 percent defective batteries will be accepted 95 percent of times, and lots containing 15 percent to 30 percent defective batteries will be rejected 90 percent of times.

INDIAN STANDARDS
ON
PRIMARY CELLS AND BATTERIES

IS:

203-1972 Dry batteries for flashlights (*third revision*)

267-1963 Inert cells (*second revision*)

268-1959 Leclanche' type sack cells (*revised*)

556-1960 Leclanche' type radio batteries (*revised*)

586-1964 Leclanche' type dry batteries for telecommunication, signalling and general purposes (*second revision*)

1885 (Part XV)-1967 Electrotechnical vocabulary: Part XV Primary cells and batteries

2083-1962 Flashlights

2576-1963 Dry batteries for transistor radio receivers

2652-1964 Schedule of terminals for leclanche' type primary batteries

4268-1967 Air depolarized primary wet cells

6303-1971 General requirements and tests for dry cells and batteries

6648-1972 Carbon electrodes for dry cells and batteries

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